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OPERATING EXPERIENCE WEEKLY SUMMARY

Office of Nuclear and Facility Safety

January 1 - January 7, 1999

Summary 99-01

Operating Experience Weekly Summary 99-01

January 1 through January 7, 1999

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EVENTS

1. GLOVEBOX PRESSURIZED WHEN PIPE FITTERS REPLACE AIR-LINE ADAPTER

On December 28, 1998, at the Rocky Flats Environmental Technology Site, pipe fitters inadvertently pressurized a glovebox when they attempted to replace an adapter on an air-line. The pipe fitters loosened the adapter to replace it and noticed that four of the glovebox gloves began to inflate and that the glovebox magnehelic gauge indicated zero. They immediately closed an air-line valve to isolate the air and protect the glovebox from further pressurization. The pipe fitters evacuated the area and notified the building configuration control authority of the event. Although no air monitors alarmed, radiological control technicians posted the room to require respiratory protection. They surveyed the room and the glovebox and determined that pressurization of the glovebox did not cause any spread of contamination. The technicians also obtained a high-volume air sample from the area and determined that there was no airborne contamination. Investigators determined that engineering personnel had orally approved the adapter change without performing a system walk-down to determine if a lockout/tagout was required, violating the site lockout/tagout program. They also determined that this event was similar to another event that had occurred approximately three weeks earlier at the same facility. In the earlier event, failure to perform a system walk-down resulted in pipe fitters loosening a pressurized air supply line connection that was not locked out or tagged out. In this event, failure to follow the established lockout/tagout program could have resulted in airborne contamination, room contamination, and personnel contamination and could have led to personnel uptakes. (ORPS Report RFO--KHLL-771OPS-1998-0050)

Investigators determined that the pipe fitters were replacing the air-line adapter to permit proper connection of an ejector pump that they planned to use to purge the system. The pipe fitters noticed that the existing air-line adapter was not the same size as that on a drawing, so they contacted engineering personnel. Engineering personnel orally approved the adapter change and informed the pipe fitters that the work package included a generic step to change the adapter if such a change was necessary. However, no one performed a detailed system walk-down to determine if the system was depressurized or if a lockout/tagout was necessary. The workers observed two other branch air lines that were not plugged and were not leaking air. Therefore, they incorrectly assumed that all airlines were isolated upstream, with proper lockouts and tagouts, and began replacing the adapter.

The facility manager held a fact-finding meeting on this event. Meeting attendees learned that the personnel involved incorrectly believed that the adapter change could be considered a minor tool change. They also learned that a lockout/tagout is not required for minor tool changes or adjustments when an operator is in exclusive control of an on-off or isolation switch. Attendees learned that lockout/tagout procedures require facility personnel to perform a system walk-down to ensure all isolation points are identified and locked out and tagged out before work begins and that no one had performed such a walk-down. They also learned that lockout/tagout procedures require lines pressurized to 30 pounds or greater to be locked out and tagged out with two valve isolation points and that the air supply line was pressurized at greater than 30 psig. Meeting attendees learned that misinterpreting the adapter replacement as a minor tool change was a contributing factor in this event. The facility manager will continue to review the event and develop corrective actions as necessary.

NFS reported a similar event at Rocky Flats in Weekly Summary 98-49. On December 4, 1998, pipe fitters loosened a connection to bleed off residual air in an air supply line and realized that the line was still pressurized and not locked out or tagged out. They were performing maintenance to remove the air actuator from an air-operated valve when they discovered that one

of two air supply lines that they were working on was not isolated. Investigators determined that no one had performed a system walk-down to ensure all system isolation points were identified and locked out and tagged out before the pipe fitters began work. (ORPS Report RFO--KHLL-771OPS-1998-0048)

NFS has reported in several Weekly Summaries events where pressurized lines and equipment were not locked out and tagged out. Following are some examples.

- Weekly Summary 98-02 reported that subcontractors at the Hanford Site removed a valve from steam piping and reinstalled it while the valve was an isolation point for a lockout/tagout. They removed the valve with its tag and physical locking mechanism still installed. This violated the site lockout/tagout program. Fortunately, no steam was being supplied to the line where the workers were removing the valve. (ORPS Report RL--PHMC-200LWP-1998-0001)

- Weekly Summary 97-50 reported that an L-Reactor facility operator at the Savannah River Site installed a lockout on the wrong lockout point for maintenance on a compressed air system. Independent verification of the lockout failed to catch the error. (ORPS Reports SR--WSRC-REACL-1997-0013)

- Weekly Summary 97-45 reported several lockout/tagout events. OSHA inspectors at Oak Ridge National Laboratory observed that millwrights had not reverified a single-point lockout before resuming repair work. Maintenance mechanics at the Idaho National Engineering and Environmental Laboratory installed a lockout/tagout on an instrument air-line, then cut an adjacent, but incorrect, air-line. (ORPS Reports ORO--ORNL-X10PLEQUIP-1997-0011 and ID--LITC-SMC-1997-0007)

These events underscore the importance of using an integrated approach to safety that stresses clear goals and policies, individual and management accountability and ownership, implementation of requirements and procedures, and thorough and systematic management oversight. The responsibility for ensuring adequate planning and control of work activities resides with line management. Managers should ensure that work control processes are followed and facility practices are enforced. Safety and health hazard analyses must be included in the work control process to help prevent worker injury. The hazard analysis process should include provisions for lockouts/tagouts, job-specific walk-downs, integration of work activities, and personnel protective equipment. Pre-job briefings, facility procedures, and training programs should emphasize the dangers associated with job-specific activities. Maintenance personnel should ensure that equipment is properly locked and tagged out before performing maintenance or troubleshooting activities. In the December 4, 1998 Rocky Flats event, the pipe fitters were paying attention to detail. They noticed that the line pressure was not bleeding off and took the appropriate action when they isolated the air, stopped work, and reported the event.

This event also demonstrates the importance of multiple engineered barriers to prevent hazardous events. Although human performance (supported by procedures, policies, memoranda, or standing orders) is a standard barrier to preventing mechanical rotating hazards, pressurized component hazards, and electrical shocks, the probability of prevention can be increased by adding physical barriers such as lockouts and tagouts.

A good lockout/tagout program is an important element of an effective conduct of operations program. Lockout/tagout programs in DOE serve two functions. The first function, defined in both 29 CFR 1910, *Occupational Safety and Health Standards*, and DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities,* is to protect personnel from injury and protect equipment from damage. The second function is to provide overall control of equipment and system status. Lockouts/tagouts are typically applied during maintenance activities; however, there are many cases when lockouts/tagouts are needed for personnel safety. The standard states that an effective lockout/tagout program requires three elements: (1) all affected personnel

must understand the program; (2) the program must be applied uniformly in every job; and (3) the program must be respected by every worker and supervisor.

Managers and supervisors in charge of job performance should ensure that hazards are identified and corrected. DOE facility managers should ensure that personnel understand the basics of work control practices and safety and health hazard analyses. Personnel in charge of system design changes should ensure that facility documentation, including drawings, is up-to-date and accurate. Following are some of the many documents that facility managers should review to ensure they are incorporated in current facility safety programs.

- DOE O 4330.4B, *Maintenance Management Program,* chapter 6, provides guidance for preparing and using procedures and other work-related documents that contain appropriate work directions. Section 6.2 states that experience has shown that deficient procedures and failure to follow procedures are major contributors to many significant and undesirable events.

- DOE-STD-1030-96, *Guide to Good Practices for Lockouts and Tagouts*, section 1, "Introduction," states that the primary purpose of lockout/tagout programs is to protect employees from exposure to potential hazardous energy sources. This standard also states that lockout/tagout programs promote safe and efficient operations and are an important element of conduct of operations programs.

- DOE-STD-1073-93-Pt.1 and -Pt.2*, Guide for Operational Configuration Management Programs, Including the Adjunct Programs of Design Reconstitution and Material Condition and Aging Management*, provides guidelines and good practices for an operational configuration management program including change control and document control.

- DOE-STD-1120-98, *Integration of Environment, Safety, and Health into Facility Disposition Activities*, provides guidance for enhancing worker, public, and environmental safety. This standard supports integrated safety management system principles to guide the safe accomplishment of work activities. These principles include (1) line management responsibility for safety; (2) clear roles and responsibilities; (3) competence commensurate with responsibilities; (4) balanced priorities; (5) identification of safety standards and requirements; (6) hazard controls tailored to work being performed; and (7) operations authorization.

- DOE/EH-0540, Safety Notice 96-05, *Lockout/Tagout Programs,* summarizes lockout/tagout events at DOE facilities, provides lessons learned and recommended practices, and identifies lockout/tagout program requirements.

- The *Hazard and Barrier Analysis Guide*, developed by OEAF, discusses barriers that provide controls over hazards associated with a job. The guide also provides a detailed analysis for selecting optimum barriers, including a matrix that displays the effectiveness of different barriers in protecting against some common hazards.

DOE technical standards are available at http://www.doe.gov/html/techstds/techstds.html. OSHA regulations are available at http://www.osha-slc.gov/OshStd_data. Safety Notice 96-05 can be obtained by contacting the ES&H Information Center, (800) 473-4375, or by writing to U.S. Department of Energy, ES&H Information Center, EH-72, 19901 Germantown Rd., Germantown, MD 20874. Safety Notices are also available at http://tis.eh.doe.gov:80/web/oeaf/lessons_learned/ons/ons.html. A copy of the *Hazard and Barrier Analysis Guide* is also available from the ES&H Information Center or at http://tis.eh.doe.gov:80/web/oeaf/tools/hazbar.pdf.

KEYWORDS: conduct of operations, maintenance, personnel error, procedures

FUNCTIONAL AREAS: Maintenance, Procedures, Industrial Safety, Hazards Analysis, Work Control

2. ELECTRICAL PANEL FIRE

On December 18, 1998, at the Hanford Remedial Action Projects, a subcontractor custodian working in a change trailer discovered a fire in a hot water heater electrical panel and attempted to control it before being forced by the buildup of dense smoke to evacuate the trailer. The custodian suffered mild smoke inhalation. Physicians at a local hospital treated the custodian, and he was able to return to work the following day. Employee response to emergency situations can greatly impact the outcome of the situation, and improper response may expose the responding employee to unacceptable hazards that can result in severe injury or death. (ORPS Report RL--BHI-REMACT-1998-0009)

Investigators determined that the custodian was in the trailer performing janitorial duties when he discovered the fire. The change trailer, which was manufactured in 1994, had four shower stalls and a sink. It also had a 220-V, 10 gal/min industrial water heater. When the custodian arrived at the change trailer, he discovered that one of the showers was running and that there were several inches of water on the floor. He attempted to shut off the water but was unsuccessful. He opened the door to a small closet to retrieve a broom and clean up the water on the floor. This closet also contained the hot water heater. The custodian did not notice any problems at that time. Some time later, he heard popping sounds coming from the closet. While he was investigating these sounds, the door on the front electrical panel of the water heater blew open and he observed flames and smoke coming from the panel. The custodian attempted to keep the flames from reaching the overhead ceiling panels using a broom. He was forced by the dense smoke to evacuate the trailer and he propped open the rear door of the trailer on his way out. The custodian went to an adjacent office trailer to notify management and, finding no one there, paged the project manager and waited several minutes for a return call. The call was not returned, so he returned to the change trailer and discovered that the fire had self-extinguished and that smoke was clearing out of the trailer. A short time later, project personnel arrived at the trailer and the custodian informed them of the incident. The following actions were taken by project managers upon being informed of the incident.

- They notified the Hanford Fire Department. A battalion chief responded to verify that the fire was out.
- They transported the custodian to a site first aid station to be evaluated for potential smoke inhalation. He was later transported to a local off-site hospital for further evaluation.
- They instructed that the breaker feeding the hot water heater be locked and tagged out of service.
- They made appropriate notifications.
- They informed the company that set up the trailer and asked them to research problems with the hot water electrical components and feeds.

While the electrical panel on the hot water heater was too badly burned to identify the cause of the fire, technical experts stated that the most probable cause of the fire was a loose wire in the hot water heater electrical panel. They also determined that the failed shower valve contributed to the fire because it caused the water heater to operate continuously. Investigators determined that the

custodian failed to make a timely notification to the fire department. The subcontractor will provide its personnel with additional training on site emergency response and notification requirements.

NFS has reported emergency response inadequacies in past Weekly Summaries. Following are some examples.

- Weekly Summary 98-50 reported that a researcher at the Pacific Northwest National Laboratory was conducting an experiment in a fume hood when a vessel ruptured and expelled its contents out of the fume hood. When the researcher discovered the mishap, he shut off the equipment and vacated the laboratory, going to an adjacent space from which he could observe the laboratory through a window. Although he knew there was a potential for fire, he did not immediately notify emergency response personnel. (ORPS Report RL--PHMC-PNNLBOPER-1998-0022)

- Weekly Summary 98-02 reported that an ice plug in the cooling discharge piping of a diesel-driven standby raw water pump caused the engine to overheat, igniting the wrapping on insulation for the turbocharger and exhaust piping at the Idaho National Engineering and Environmental Laboratory. Operators went to check the diesel standby pump and found the building filled with smoke and the diesel engine making unusual noises. Investigators reported that one of the operators entered the smoke-filled building and shut down the diesel engine while others called the fire department. Damage was limited to the diesel engine, and there were no injuries as a result of this occurrence. (ORPS Report ID--LITC-LANDLORD-1998-0001)

Employees who try to manage fires put themselves at risk of grave injury. Their actions may save equipment from further damage, but such a risk is never warranted. According to the NFPA, the most common hazard to humans in a building fire is from smoke and toxic gases. Most building-related fire deaths are directly related to the products of combustion.

DOE O 420.1, *Facility Safety*, and DOE O 440.1, *Worker Protection Management for DOE Federal and Contractor Employees*, offer broad objectives in fire protection and rely principally on NFPA codes and standards and the fire protection requirements of local building codes.

Ordering information for NFPA documents can be found at the NFPA home page, http://www.nfpa.org. DOE fire protection references can be found at the DOE fire protection home page, http://nattie.eh.doe.gov:80/fire/directives.html.

KEYWORDS: fire, emergency

FUNCTIONAL AREAS: Fire Protection, Industrial Safety

3. SCIENTIST RECEIVES LEAD EXPOSURE

On December 21, 1998, at the Hanford Site Pacific Northwest National Laboratory, a scientist was exposed to airborne lead particulates that exceeded the OSHA permissible exposure levels (PELs) while he cut epoxy-mounted lead- and lead-oxide-containing plates with a water-cooled tile saw. The scientist's 8-hour time-weighted average exposure was 138 µg/m^3, which exceeds the OSHA 8-hour permissible exposure level of 50 µg/m^3. Investigators determined that the scientist also cut lead plates twice between December 14 and 18 using the water-cooled tile saw, but that no one performed lead monitoring during that time. Exposure to lead can have serious acute

and chronic health effects. Inhalation is the primary means of taking lead into the body, but it may also be absorbed through the digestive tract. Acute lead exposure may result in acute encephalopathy, which develops quickly into seizures, coma, and death from cardiorespiratory arrest. However, short-term lead doses of a magnitude severe enough to result in acute encephalopathy are unusual. Chronic lead exposure may result in severe damage to blood-forming, nervous, urinary, and reproductive organs. (ORPS Report RL--PNNL-PNNLBOPER-1998-0023)

Investigators determined the scientist was refining a technique to cut lead plates because facility personnel will need to perform such work over the next several years. Facility personnel developed a procedure to use a water-cooled band saw to perform the work. Investigators determined that an industrial hygienist had reviewed the procedure and told facility personnel that although he believed the airborne lead levels would be acceptable, they should ensure personnel monitoring is provided whenever lead processing begins. Facility personnel misinterpereted the industrial hygenist's request. They believed that monitoring was needed at the point where the cutting technique was developed, so the sample would be representative of the lead cutting program that they would be implementing and would accurately assess any potential chronic lead exposure. Investigators determined that when the scientist used the water-cooled band saw before December, he encountered difficulty in cutting the lead plates and switched to a water-cooled tile saw. They determined that no one told the industrial hygienist about the equipment change.

The facility manager held a critique of this event. Critique members learned that communication difficulties between facility personnel and the industrial hygenist had contributed to this event. They learned that the work control process was deficient in that it did not accurately identify the lead hazard, delineate the proper protective equipment that personnel should have used, or ensure airborne monitoring was performed when cutting activities were taking place. They also learned that although facility personnel knew it was possible that the lead could become airborne during this process, they accepted the risk because they believed the exposure would be slight. Facility personnel will continue to develop a process that provides adequate personnel protection for lead tile cutting. The facility manager will continue to review this event and develop corrective actions as necessary.

OEAF engineers searched the ORPS database and identified several events where work planning or performance deficiencies resulted in elevated exposures to hazardous substances. The following are some examples.

- Weekly Summary 98-51 reported two occurrences at the Sandia National Laboratory involving elevated exposures of employees to hazardous metals. In the first event, two employees received exposures to cadmium and lead fumes or dust that exceeded OSHA PELs. The cadmium exposure was 4.5 times the PEL and the lead exposure was 1.5 times the PEL based on analysis of breathing zone air samples. The employees were using a torch to cut metal that had been excavated from a waste landfill. They were not wearing protective equipment specific to fumes generated by thermal cutting of cadmium or lead, nor were they wearing respiratory protection equipment. Investigators could find no evidence that planners had considered fume hazards in advance. In the second event, a radiation protection technician was exposed to cadmium dust at twice the PEL. The technician had been surveying materials removed from a waste landfill and sweeping dust from shelves in his area. The facility manager ordered supervisors to revise work procedures to require full-face respirators during dust-removal operations. (ORPS Reports ALO-KO-SNL-10000-1998-0006 and ALO-KO-SNL-6000-1998-0006)

- Weekly Summary 98-42 reported that two workers at the Idaho Waste Experimental Reduction Facility had been exposed to airborne cadmium dust at levels that exceeded the protection factor for the respiratory protection equipment

they were using. The individual workers could have been exposed to as much as 1.16 and 2.68 times the PEL for cadmium dust, 5 µg/m^3. The workers were cleaning and inspecting an incinerator off-gas heat exchanger following a test burn for equipment qualification. Metallic cadmium was one of the materials injected before the cleaning and inspection activity. Although facility operators had encountered cadmium dust above the PEL in the heat exchanger during past cleanings, engineers did not expect the very high levels encountered during this task. The facility manager directed facility personnel to revise the Lead and Cadmium Compliance Plan to require a more protective respirator and also to develop more effective engineering and administrative controls to mitigate cadmium hazards. (ORPS Report ID--LITC-WERF-1998-0007)

- Weekly Summary 98-19 reported that the DOE manager of the Idaho National Engineering and Environmental Laboratory Waste Reduction Operations Complex transmitted a surveillance report to the contractor manager identifying deficiencies in the contractor's program for controlling worker exposure to lead and cadmium at the Waste Experimental Reduction Facility incinerator baghouse. The facility manager prohibited entry into the baghouse until facility personnel had developed and implemented effective engineering and administrative hazard controls. Inadequate hazard analysis and control caused at least one worker to be exposed to airborne lead and cadmium dust that exceeded OSHA limits. (ORPS Report ID--LITC-WERF-1998-0004)

- Weekly Summary 98-14 reported that facility managers at the Savannah River Technology Center determined that elements of the lead compliance program did not provide adequate guidance to protect workers. Based on program deficiencies identified by facility managers, the Center operations manager curtailed all Center lead handling performed without the approval of a facility industrial hygienist. (ORPS Report SR--WSRC-LTA-1998-0012)

These events underscore the importance of performing a thorough activity hazard analysis for all jobs, especially those that are new activities or those that have been changed. In the Hanford event, facility personnel accepted an unknown risk when they cut the lead tiles without anyone monitoring to determine if airborne lead was being generated. In addition, they did not adequately protect the scientist who performed the cutting operation. A conservative decision would have been to require the scientist to wear respiratory protection and to require the industrial hygienists to monitor the technique the first time it was performed and whenever the equipment was changed. Uncertainties surrounding contamination levels that could be encountered during work dictate highly conservative approaches to work planning and to selecting and using respiratory protection equipment. Industrial hygienists and work planners should review the following guidance.

- DOE O 440.1A*, Worker Protection Management for DOE Federal and Contractor Employees*, requires all DOE elements to identify existing and potential workplace hazards and evaluate the risk of associated worker injury or illness. The Order also requires DOE elements to assess worker exposure to chemical, physical, biological, or ergonomic hazards through appropriate workplace monitoring (including personal, area, wipe, and bulk sampling), biological monitoring, and observation.

- DOE O 5480.4, *Environmental Protection, Safety and Health Protection Standards*, requires compliance with many regulations and permits, such as the Resource Conservation and Recovery Act. The Act specifies treatment, storage, and disposal requirements for hazardous materials such as lead "from cradle to grave." Failure to comply exactly with these environmental regulations can result in civil penalties.

- 29 CFR 1910.1000, *Airborne Contaminants*, states that whenever feasible, compliance with exposure limits for airborne contaminants must be achieved by determining and implementing administrative or engineering controls. If administrative or engineering controls are not feasible to achieve full compliance, protective equipment or other protective measures must be used to keep the exposure of employees to air contaminants within prescribed limits.

- 29 CFR 1910.134, *Respiratory Protection*, states that whenever respirators are required to protect the health of employees, the employer must establish and implement a written respiratory protection program with worksite-specific procedures. The program must be updated as necessary to reflect changes in workplace conditions that affect respirator use. The standard also states that when employers cannot identify or reasonably estimate the employee exposure, they must consider the atmosphere immediately dangerous to life and health, which requires use of a full-face, pressure-demand, self-contained breathing apparatus or a supplied-air respirator with an auxiliary self-contained air supply.

- 29 CFR 1926.62, *Lead*, applies to employees who may be occupationally exposed to lead. The regulation states that the employer shall ensure that no employee is exposed to lead at concentrations greater than 50 $\mu g/m^3$ of air averaged over an 8-hour period. The regulation also states, in part, that until an employer performs an exposure assessment, the employer shall treat the employee as if he or she had been exposed above the PEL and shall implement employee protective measures, including respiratory protection, awareness training, and blood sampling.

Additional information on lead may be found at the National Lead Information Center. The Center's primary goal is to gather and provide information on environmental lead poisoning and prevention for health professionals and the public at large. The Center may be reached at 800-LEAD-FYI. The Center also operates a clearinghouse (800-424-LEAD) staffed by trained information specialists who can provide in-depth technical information on lead-related issues and a website at http://www.nsc.org/ehc/lead.htm.

OSHA standards may be found at http://www.osha-slc.gov/. Additional information on occupational exposure to lead may be found at http://www.osha-slc.gov/SLTC/Chemicals.html.

KEYWORDS: hazard analysis, industrial hygiene, respirator, work planning

FUNCTIONAL AREAS: Industrial Safety, Work Planning

4. FALL PROTECTION SYSTEM VIOLATIONS

On December 10, 1998, at the Argonne National Laboratory, two subcontractor employees climbed over a guardrail and into the top of a cooling tower without securing their fall protection lanyards to a tie-off point. Their actions could have resulted in a fall of approximately 35 feet. The employees received a warning. The next day, the same two employees again climbed over the guardrail and onto the tower without securing their lanyards. They were ordered to vacate the cooling tower. This occurrence is significant because falls are the single greatest contributor to construction injuries and deaths. (ORPS Report CH-AA-ANLE-ANLEPFS-1998-0010)

Investigators determined that the work plan in effect required fall protection at all times above 6 feet. Each of the two employees was wearing a body harness equipped with two individually

attached lanyards. Facility personnel took prompt and decisive actions in accordance with the Laboratory's construction process disciplinary procedures. These actions included the following.

- Laboratory environment, safety, and health construction inspectors and facility construction field representatives met with the subcontractor's field supervisors to discuss the occurrence.

- The facility issued safety violation notices to the subcontractor and suspended the two subcontractor employees for 6 months.

- The facility project manager informed the subcontractor's corporate office of the violations.

NFS has reported numerous fall protection violations in the Weekly Summary. Following are some examples.

- Weekly Summary 98-44 reported that a facility management walk-around team at Los Alamos National Laboratory Plutonium Processing and Handling Facility observed two subcontractor pipe fitters violating fall protection procedures while installing copper tubing for a boiler replacement project. One pipe fitter was standing on a 3-inch diameter pipe suspended 10 to 12 feet above the floor. The other pipe fitter was on a stepladder and attempting to solder while he was holding acetylene bottles. Neither was using fall protection equipment, which violated facility procedures and OSHA requirements. The walk-around team directed the pipe fitters to stop work immediately. Investigators determined that neither worker had completed general hazard awareness training, scaffolding training, or ladder safety training. (ORPS Report ALO-LA-LANL-TA55-1998-0048)

- Weekly Summary 98-05 reported that a construction safety coordinator at Lawrence Berkeley National Laboratory performing a daily safety compliance inspection observed subcontracted workers violating safety procedures while removing ductwork. One worker was standing on a crane walkway with the crane not locked out or tagged out, as required by facility procedures. Another worker was working on a maintenance platform approximately 25 feet high without using fall protection equipment. (ORPS Report SAN--LBL-OPERATIONS-1998-0002)

- Weekly Summary 97-42 reported that a safety inspector at the Los Alamos National Laboratory initiated a stop-work order to a roofing subcontractor because of repeated fall protection violations. In the final event, the safety inspector observed a subcontractor safety monitor assisting in roofing activities after he had been counseled that his purpose was to be a dedicated safety monitor with no other responsibilities. (ORPS Report ALO-LA-LANL-LANL-1997-0002)

- Weekly Summaries 96-08 and 96-27 reported a fatal fall at the Idaho National Engineering Laboratory. A subcontractor project engineer who was not wearing fall protection fell 17 feet from a temporary platform. The engineer suffered fatal head and neck injuries and died. The temporary platform had no guardrails, toe boards, or other fall protection. The Office of Environment, Safety and Health issued a Type A Accident Investigation Board Report stating that work planners had not addressed fall hazards and that there were no barriers in place to prevent the accident. (ORPS Report ID--LITC-RWMC-1996-0001)

These occurrences underscore the importance of establishing and enforcing an effective fall protection program. OSHA 3106, *Fall Protection in Construction*, provides an overview and discussion of fall protection topics and related standards. The introduction to this publication

states that falls are the leading cause of worker fatalities in the construction industry in the United States. Each year, on average, falls at construction sites kill between 150 and 200 workers and injure more than 100,000. OSHA recognizes that accidents involving falls are usually complex events that involve a variety of factors. Consequently, the OSHA standard for fall protection includes both human- and equipment-related issues in protecting workers from fall hazards. For example, employers and employees need to do the following.

- Where protection is required, select fall protection systems appropriate for the situation.
- Ensure that safety systems are properly constructed and installed.
- Supervise employees properly.
- Use safe work procedures.
- Train workers in the proper selection, use, and maintenance of fall protection systems.

The actions taken at Argonne are consistent with recurring themes in the lessons learned from previous fall protection violations: continuous oversight of subcontractor activities and decisive disciplinary action. Facility operators need to exercise enough oversight to ensure that subcontractors comply with safety requirements. Subcontractors will take safety requirements more seriously if they realize that frequent or flagrant violations result in dismissal or make future contracts difficult or impossible to win.

Workers need to realize that safety requirements are developed to protect them, not simply to satisfy requirements. In general, DOE prime contractors have satisfactorily incorporated the requirements of 29 CFR 1926, Subpart M, *Fall Protection*, into site and facility construction and procurement programs. However, fall protection safety violations continue to occur throughout the complex, principally among subcontractors, for reasons that are difficult to determine. Subcontracted construction workers come from a variety of backgrounds, not all of which may promote the level of safety consciousness required of DOE contractor and subcontractor employees. Employees may feel that using fall protection equipment is more trouble than it's worth, or that it's needed only by workers with less coordination, balance, or skill. In some cases, employees may get into situations that work planners had not anticipated, and may not recognize the requirement for fall protection equipment. Subpart M of 29 CFR 1926 requires employers to provide training that teaches employees who might be exposed to fall hazards how to recognize such hazards and how to minimize them. Employees must be trained in the nature of fall hazards in the work area, the standards of Subpart M, and the role of employees in fall protection plans. Employers must prepare a written certification that identifies the employee trained and the date of the training, and the employer or trainer must sign the certification record. In addition, pre-job briefings and walk-downs should include identification of fall hazards and discussion of the protective equipment to be used.

OSHA 3106 and other information related to fall protection can be downloaded from the OSHA construction home page at http://www.osha-slc.gov/html/construction.html.

KEYWORDS: construction, fall protection

FUNCTIONAL AREAS: Construction, Industrial Safety

5. AS-FOUND CONDITIONS AFFECT SAFETY OF DECOMMISSIONING OPERATIONS

On December 30, 1998, at the Oak Ridge National Laboratory East Tennessee Technology Park, the K-33 Building operations manager reported a trend in a series of unrelated incidents that affected the safety of decommissioning operations. The operations manager was conducting an integrated safety management review of five different incidents, two of which had resulted in minor injuries to workers. In each of these incidents, the as-found/as-built conditions of building components being disassembled and decommissioned were not per the facility design or not per the expected facility conditions established in pre-job walk-downs. The integrated safety management review of these incidents was a good practice that resulted in the development of lessons learned to enhance the safety culture and overall safety of the project. (ORPS Report ORO--BNFL-K33-1998-0016)

The following five incidents resulted from as-found/as-built conditions that were not in accordance with facility design or expected conditions during decontamination and decommissioning.

- While workers dismantled two sections of ventilation duct, one section unexpectedly came loose from the other and fell to the floor. No one was injured. The workers discovered that the ducts, which were designed to be interconnected with duct “pocket locks,” were not so connected.

- A worker strained her shoulder while trying to unbolt a ventilation duct riser. The nut was tack-welded, which was not the normal configuration for this type of bolt on the ductwork.

- Workers believed that a section of pipe being removed as part of asbestos abatement activities was adequately supported on two pipe supports. However, one of the pipe supports was not properly connected, thereby allowing the pipe to fall after workers had cut the pipe free. No one was injured as a result of this incident. (ORPS Report ORO--BNFL-K33-1998-0008)

- A worker making a cut in a section of structural steel assumed that the steel was anchored at its connection points per the structural design. However, the steel piece was not anchored (one side had no bolts, and the other side had bolts without nuts), and as the worker was making the cut, it fell, striking the worker on his hardhat, respirator, and forearms. The worker's right forearm was slightly injured.

- While workers removed a ductwork damper on a filter housing roof, the damper fell through the roof. It struck a section of fire pipe before falling to the floor. The pipe did not break and no one was injured. Workers discovered that the bolts that normally connect the damper assembly to the filter house roof were missing.

In each of these incidents, the facility/equipment being disassembled was not in the condition expected based on facility design or past experience in removing similar components in other parts of the facility. The decommissioning project involves removal of many redundant components at different locations around the facility. These incidents show that the as-found/as-built condition of redundant components cannot be assumed to be the same at each location.

The direct cause of the incidents was equipment/material problem (defective or failed part), in that the building conditions/configuration were not consistently as expected based on facility design or on walk-downs of representative portions of the components being removed. There were two contributing causes. The first was a lack of attention to detail when workers performed pre-job walk-downs and inspections of their work area and tasks. If they had taken additional time to inspect in detail the configuration of the components they were to remove, many of these

incidents could have been avoided. The second contributing cause was that there was not enough planning and preparation of the work scope to ensure that unknown conditions were identified. In general, the enhanced work planning process focused on the planned condition of the work based on known component design or based on walk-downs of a representative sample of the items to be removed. A cause-effect analysis of the trend identified in these incidents indicated that the root cause was also a management problem (work organization/planning deficiency).

Project management personnel determined that these types of incidents are compounded by the repetitive nature of much of the work. In many cases, the same basic component removal task may have to be performed hundreds (or even thousands) of times. In virtually all cases, the component condition will be as expected based on the facility design and, therefore, as planned in the enhanced work planning process. For this reason, workers may become complacent and less careful about performing work inspections to the level of detail and rigor that is necessary to avoid an accident.

Project management personnel identified and implemented the following corrective actions.

- Provided toolbox (pre-job) briefings on the hazards of unexpected/unidentified as-found/as-built conditions.

- Provided an on-location briefing on the structural steel incident that had resulted in an injury. The briefing stressed the importance of taking sufficient time to carefully inspect the work location to establish the physical condition of components being removed before starting the task.

- Prepared a lessons-learned bulletin to remind workers about the importance of using pre-job inspections as part of an integrated safety management approach to work to prevent accidents from unexpected as-found work conditions.

There were three main lessons learned from these five incidents.

- The importance of performing high quality pre-job inspections of the work locations to ensure that all workers are aware of the job conditions.

- The effectiveness of the on-location briefing in communicating the circumstances of that particular incident. The briefing made the lessons learned more real to the workers who participated because they were able to see first-hand the conditions that led to the incident. An on-location briefing can be a highly effective means of reinforcing the principles of integrated safety management because it makes the information and integrated safety management philosophy real and practical for project workers.

- The value of performing integrated safety management trend analysis of seemingly unrelated incidents (such as near misses, injuries, and other incidents) in order to identify trends and take corrective actions that could prevent future workplace incidents or injuries.

NFS recently reported two other events in its Weekly Summary in which the as-found conditions were not as expected during decommissioning activities.

Weekly Summary 98-50 reported a good practice involving hazard identification during decommissioning at the Oak Ridge National Laboratory East Tennessee Technology Park. Facility personnel identified a potential unreviewed safety question when they discovered five large tanks that could have contained chlorine trifluoride or fluorine. These chemicals are strong

oxidizers that can ignite metal when exposed to unprepared surfaces or become explosive upon contact with organic materials. If either chemical is released, the environment would become immediately dangerous to life and health. Facility personnel had previously received lessons learned training to ensure that they make sound decisions and judgements based on reliable information and not just on previously documented facility conditions that are likely to be incomplete or inaccurate. (ORPS Report ORO--BNFL-K33-1998-0015)

- Weekly Summary 98-31 reported that during decommissioning, operations workers at the Oak Ridge National Laboratory East Tennessee Technology Park discovered that a lube oil system in a shut-down gaseous diffusion plant contained approximately 3,400 gallons of oil. Investigators determined that decommissioning contractor personnel believed the lube oil system contained only residual amounts of oil, because the previous contractor reported that its workers had drained the system as part of deactivation. (ORPS Report ORO--BNFL-K33-1998-0003)

DOE/EM-0142P, *Decommissioning Handbook*, March 1994, DOE Office of Environmental Management, Chapter 12, "Worker Protection," provides requirements for worker protection during decontamination and decommissioning activities. Although the handbook is not an active document (the Office of Environmental Management is revising it), it provides valuable guidelines that may be used until the revision is complete. The handbook states that worker protection is an important element of any project. It divides worker protection issues into three categories: (1) protection from radiation; (2) protection from toxic and hazardous materials; and (3) protection from traditional industrial safety hazards. The handbook also points out that complete knowledge of the facility to be decommissioned may not be available, which is especially likely if the operational history is long or if a lot of time has passed since operations ceased. Records tend to become lost or difficult to retrieve, and knowledgeable people forget important details or cannot be reached. In the worst case, a decommissioning project has to be performed based solely on information gained during site characterization.

Facility managers should review DOE G 450.4-1, *Integrated Safety Management System Guide for Use with DOE P 450.4, Safety Management System Policy, and DEAR Safety Management System Contract Clauses*, which describes the principles and functions that must be addressed in an effective integrated safety management program. Integrated safety management information can be found at the Safety Management website, http://tis-nt.eh.doe.gov/ism.

KEYWORDS: decommissioning, hazard analysis, pre-job briefing, pre-job planning, safety

FUNCTIONAL AREAS: Decontamination and Decommissioning, Integrated Safety Management

6. NEAR MISS WHILE REMOVING MANWAY ON ELEVATED STORAGE TANK

On December 22, 1998, at the Pantex Plant, a gasket between an access manway and the column flange on an elevated water storage tank blew out, spraying water approximately 30 feet. Crafts personnel were in the process of removing the manway while attempting to locate and repair a water leak at the base of the 500,000-gallon tank. They had removed approximately 80 percent of the bolts holding the manway in place when the gasket blew out, bending the manway and releasing the water. They immediately disconnected their electrical tools and evacuated the area. Crafts personnel believed the manway would allow access into a dry area beneath the tank, but unknown to them or other facility personnel, the tank was configured with a wet column or riser rather than a dry one. Although there were no injuries to personnel as a result of this event, facility personnel reported it as a near miss because of the potential for injury from the force of the water or from the manway becoming a missile. This event is significant in that the configuration of the tank was not known before repair work on the leak began. (ORPS Report ALO-AO-MHSM-PANTEX-1998-0093)

Utilities personnel shut off distribution pumping to allow water in the tank to be consumed. Their concern over the pressure exerted on the manway (estimated at 55 psi) eventually led them to isolate the tank and a section of piping and then drain the water through a low-pressure fireplug. When the water stopped spraying from the manway, they opened a drain valve and completely drained the tank.

The tank is fairly new, having been constructed about 5 years ago by the U.S. Army Corps of Engineers. Elevated 140 feet above the ground, it is more than simply a container for a large quantity of water. Its principle function is to furnish potable water and fire protection water at a usable pressure that is not subject to wide fluctuations. Investigators reviewed an engineering drawing of the tank, which contained a note indicating that the tank could be configured with a wet riser or with a dry riser. However, there was nothing that indicated which type had been used. The steel riser connects to the bottom of the tank and descends to the foundation. It can house piping, valves, and access ladders. They also determined that the manway bore no warning against removing it without first draining the storage tank. Facility managers continue to investigate the cause of this event.

NFS reported an event in Weekly Summary 94-34 in which firefighters responding to a fire alarm at Pantex found that the fire hydrants were not in service. The valves that isolated the hydrants had been installed as part of a new building construction project and their configuration was not known or controlled. The ORPS report for this event said that when new facilities are transferred from the Corps of Engineers to DOE and subsequently to Mason & Hanger, the management and operating contractor, a system should be in place to verify equipment line-up and status. As a result of this event, Mason & Hanger prepared a plant standard that assigned responsibility for turnover of new buildings and systems at Pantex. (ORPS Report ALO-AO-MHSM-PANTEX-1994-0129)

This event underscores the importance of ensuring that information on the exact configuration of new systems or components is properly transferred from the construction organization to the operating organization. It is important that the as-built condition be reflected in the documentation. Physical inspections should be performed to verify that documentation depicts the actual physical configuration and is consistent with the design requirements. DOE-STD-1073-93–Pt.1 and –Pt.2*, Guide for Operational Configuration Management Programs, Including the Adjunct Programs of Design Reconstitution and Material Condition and Aging Management*, provides guidelines and good practices for an operational configuration management program including change control and document control. The standard also provides program criteria and implementation guidance for establishing consistency among design requirements, physical configuration, and facility documentation and for maintaining this consistency. The standard states that an effective configuration management program will increase the availability and retrievability of accurate information to support safe, sound, and timely decision-making related to facility design and operations.

KEYWORDS: configuration control, maintenance, near miss, storage tank, water, water tank

FUNCTIONAL AREAS: Configuration Control, Mechanical Maintenance

FINAL REPORT

This section of the OEWS discusses events filed as final reports in the ORPS. These events contain new or additional lessons learned that may be of interest to personnel within the DOE complex.

1. HOIST DAMAGED DURING TROUBLESHOOTING

On January 29, 1998, at the Hanford Spent Nuclear Fuels Project, an operator discovered that a 3-ton auxiliary hoist was two-blocked. The auxiliary hoist is located on a 32-ton crane trolley. Two-blocked refers to a condition where there is mechanical binding of hoist mechanisms (wire rope and pulleys). Investigators determined that the hoist probably became two-blocked a week earlier, when crane maintenance workers operated the hoist while troubleshooting the drive control unit. (ORPS Report RL--PHMC-SNF-1998-0007)

Investigators determined that the troubleshooting team had been attempting to diagnose problems with the auxiliary hoist by operating the hoist from the keypad of the variable frequency alternating current (VFAC) drive, as directed by the manufacturer. The troubleshooting was performed under an energized work permit and a controlled work package. The VFAC drive is not located in view of the hoist, so an operator was assigned to observe the hoist and report its movement to personnel operating the VFAC drive. Investigators believe that the operator (observer) did not notice the hoist block as it moved up, and it became two-blocked when it contacted the hoist trolley structure. Investigators also determined that when the hoist is operated from the VFAC drive keypad, limit switches, including those designed to prevent two-blocking, are bypassed. Because the observer did not notice the hoist movement, personnel operating the hoist from the keypad had no knowledge of the event. At the end of the troubleshooting, the team locked out the crane circuit and left the area. Approximately one week later, an operator discovered the two-blocked condition.

Investigators determined that this occurrence was in part attributable to personnel error, because the observer did not notice the hoist was moving up and becoming two-blocked during troubleshooting. They also partly attributed the occurrence to inattention to detail because the observer did not put himself in a position to detect any motion of the hoist. If the observer realized that he could not adequately observe possible hoist movement, he could have stopped work and moved to an appropriate vantage point, and the event would have been prevented. The facility manager identified the following factors as having contributed to the occurrence.

- Administrative controls (procedures/training) were inadequate to control the work. Refer to final occurrence report RL--PHMC-SNF-1998-0011 for a combined root cause analysis for this and associated hoisting and rigging occurrences at the Spent Nuclear Fuels Project.

- The sound created by the block slowly moving into the trolley structure was obscured by other machinery noise.

- The operator assigned to observe the hoist was not in constant communication with the troubleshooting team and was not in control of the hoist.

- Movement of the block was very slow (approximately 1.6 feet per minute) and therefore difficult to detect.

- The angle of viewing also made motion difficult to detect.

- The operator assigned to observe the hoist had been involved in several earlier attempts to operate the hoist and may have become complacent because the hoist had not moved during those attempts.

- The auxiliary hoist block is yellow and, from the vantage point of the operator assigned to observe the hoist, blended in with the yellow underside of the trolley.

Construction managers are evaluating the need to develop a construction troubleshooting method. Such a method would help to ensure that appropriate controls are in place to provide

more rigor to the troubleshooting process. Managers also will formalize expectations associated with similar tasks and incorporate them into the facility training program.

This occurrence underscores the importance of attention to detail when selecting a vantage point when a task requires direct observation of equipment. It also underscores the importance of the equipment operators and the observers staying in constant contact during the time that observations are required.

KEYWORDS: hoisting and rigging, repair

FUNCTIONAL AREAS: Hoisting and Rigging, Mechanical Maintenance